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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the microwave discharge light equipment which excites the discharge medium in an electrodeless lamp by microwave, and the image display device using this microwave discharge light equipment.

[0002]

[Description of the Prior Art]Conventionally, since it was used as a device which irradiates with wide ranges, such as a lighting system, even when the microwave discharge light equipment without a well-known electrode had the to some extent wide range light-emitting part, it was satisfactory. However, although the necessity of using microwave discharge light equipment as a light source of an image display device coming to be considered, and controlling light flux by an optical system came out, since point-light-source-izing was difficult, light flux was not able to be completed and a rise in luminosity was not able to be attained in recent years. Although providing the small mask of an effective area product in the emitted light side emitted from a lamp as a means to solve this was performed, since the lamp is emitting light uniformly on the whole, it does not pass in part but the light volume emitted from an opening has become the thing which has very bad efficiency.

[0003]As shown in drawing 11, the microwave discharge light equipment indicated by JP,7-183008,A is an example using a electron cyclotron resonance of a method.

[0004]In the microwave discharge light equipment 100 as an example of the conventional example shown in drawing 11. The microwave oscillator 101 which oscillates microwave, and the waveguide 102 to which the microwave oscillated with this microwave oscillator 101 is led, The cylindrical microwave resonance cavity object 104 in which it was connected to this waveguide 102 through the feed opening 103, and the opening 104a was formed in front sides, The lamp container 105 of a hollow spherical shape in which the electroluminescence

substance which it is provided in this microwave resonance cavity object 104, and it is excited by that inside and carries out electroluminescence to it by microwave was accommodated, It has the electromagnet or the permanent magnet 107 which impresses a magnetic field to this lamp container 105 via the feeder system 106, and is constituted.

[0005]And the microwave oscillated from the microwave oscillator 101 is transmitted in the waveguide 102, and electric power is supplied in the microwave resonance cavity object 104 from the feed opening 103, Since it is generated almost in parallel with the direction of movement of microwave by the line of magnetic force 107a of the magnetic field by the electromagnet or the permanent magnet 107 when the electroluminescence substance in the lamp container 105 is excited by microwave and carries out electroluminescence by it, Spiral rotational movement as shown in the electron which exists in the lamp container 105 under the influence of this magnetic field at drawing 12 is made to cause, and what is called electronic psych roton resonance occurs. Then, the light which only a part to rotate more nearly spirally than the case where the light which carried out electroluminescence within the lamp container 105 does not add a magnetic field became long and in which the luminescence path (distance) and light emission period of light emitted light is emitted from the opening 104a of the microwave resonance cavity object 104.

[0006]

[Problem(s) to be Solved by the Invention]By the way, according to the conventional microwave discharge light equipment 100 shown in drawing 11. Although the luminescence path and light emission period of light become long and the opportunity of a part for the electron in the lamp container 105 to rotate to emit light increases, as mentioned above, since the shape of the lamp container 105 is a hollow spherical shape, If the path of rotational movement cannot be made to increase but the spherical diameter of the lamp container 105 is enlarged unless the spherical diameter of the lamp container 105 is enlarged, a light-emitting part will become large, and the microwave discharge light equipment 100 will also become large-sized.

[0007]Since the effective area product of the opening 104a which carried out the opening ahead [of the microwave resonance cavity object 104] is also large, when using for an image display device etc., problems, like it cannot become a small enough and high-intensity light source have arisen to use as the point light source.

[0008]

[Means for Solving the Problem]Microwave discharge light equipment this invention is characterized by that comprises the following.

In light of the above-mentioned problems, a magnetron in which it is made and the 1st invention generates microwave.

A resonator which said microwave was resonated and formed an opening to which light is

made to emit.

The 1st lamp section that enclosed rare gas and a discharge medium which are formed in said resonator and discharged by said microwave, and formed a longitudinal direction in a long picture toward said opening side.

An electrodeless lamp formed in one by the 2nd lamp section that enclosed only rare gas discharged by said microwave and covered a longitudinal direction outer peripheral part of said 1st lamp section, A magnetic force generating means which generates a line of magnetic force parallel to a longitudinal direction of the 1st lamp section of said electrodeless lamp, and an emission direction of emitted light from this electrodeless lamp.

[0009]The 2nd invention resonates said microwave with a magnetron which generates microwave, and. The 1st lamp section that enclosed rare gas and a discharge medium which are formed in a resonator in which an opening to which light is made to emit was formed, and said resonator, and are discharged by said microwave, and formed a longitudinal direction in a long picture toward said opening side, An electrodeless lamp formed in one by the 2nd lamp section that enclosed only rare gas discharged by said microwave and covered a longitudinal direction outer peripheral part of said 1st lamp section, A magnetic force generating means which generates a line of magnetic force parallel to a longitudinal direction of the 1st lamp section of said electrodeless lamp, and an emission direction of emitted light from this electrodeless lamp, It is microwave discharge light equipment possessing a loop gap resonator with which it was provided on an optic axis of emitted light from said electrodeless lamp, and electromagnetic induction nature and electric capacity nature were combined.

[0010]moreover -- in microwave discharge light equipment of the 2nd invention which the 3rd invention described above -- said loop gap resonator -- an approximate circle -- forming tubular -- and an inside diameter of this loop gap resonator -- a diameter of a lamp of the 1st lamp section of said electrodeless lamp -- smallness -- it is characterized by things.

[0011]In one above-mentioned microwave discharge light equipment of the inventions of the 1st - claim 3, the 4th invention carried out the opening of said opening formed in said resonator to substantial verticality to the direction of said line of magnetic force.

[0012]It was made for said magnetic force generating means to generate said line of magnetic force with a permanent magnet in one microwave discharge light equipment of the inventions of the 1st - claim 4 which the 5th invention described above.

[0013]It was made for said magnetic force generating means to generate said line of magnetic force with a magnet coil in one microwave discharge light equipment of the inventions of the 1st - claim 4 which the 6th invention described above.

[0014]an effective area product of said opening formed in said resonator in microwave discharge light equipment of the 1st which described the 7th invention above - the 6th

invention either -- a diameter of a lamp of said electrodeless lamp -- smallness -- it is characterized by things.

[0015]The 8th invention is an image display device using the above-mentioned microwave discharge light equipment of the 1st - the 7th invention either as a light source for projection for image display.

[0016]

[Embodiment of the Invention]One example of the microwave discharge light equipment concerning this invention and the image display device using this microwave discharge light equipment is described in detail with reference to drawing 1 thru/or drawing 10 below in order of <the 1st example>, the <2nd example>, and the <3rd example>.

[0017]In the microwave discharge light equipment of the sectional view showing the microwave discharge light equipment of the 1st example that requires <1st example> drawing 1 for this invention, and the 1st example that drawing 2 showed to drawing 1, The figure for explaining rotational movement of the electron by which it was generated within the electrodeless lamp under the influence of a magnetic field, the sectional view showing the 1st modification that transformed drawing 3 for some microwave discharge light equipment of the 1st example, and drawing 4 are the sectional views showing the 2nd modification that transformed some microwave discharge light equipment of the 1st example.

[0018]As shown in drawing 1, in the microwave discharge light equipment 10A of the 1st example concerning this invention, the resonator 11 is formed in cylindrical shape with the stage by the narrow diameter portion 11a and the major diameter 11b. Although the resonator 11 is formed in cylindrical shape with the stage in the example, without restricting to this, mere cylindrical shape may be sufficient and box shape may be sufficient further. The opening 11a1 which carried out the opening of the tip is formed in the narrow diameter portion 11a of the resonator 11, along with the inside diameter of this narrow diameter portion 11a, the permanent magnets 12 and 13 of falcation [section] counter mutually, and couple adherence is carried out. Although it countered mutually and one pair of permanent magnets 12 and 13 are formed in the example, it is larger for an effect at least for either to have been good and for there to be two or more pairs further, without restricting to this. It is also possible to use the permanent magnet of doughnut shape (ring shape), to replace with a permanent magnet, and to use an electromagnet.

[0019]The electrodeless lamp 14 has adhered to the opening 11a1 side inside the permanent magnets 12 and 13 of a couple in the narrow diameter portion 11a of the resonator 11. This electrodeless lamp 14 is a thing used as the important section of the 1st example, The 1st lamp 14a that formed both ends hemispherical using transparent silica glass, and enclosed long picture rare gas 15a and discharge medium 15b which form cylindrical and are discharged by microwave inside for the longitudinal direction toward the opening 11a1 side, It

forms in the shape of an ellipse using transparent silica glass, and is formed in one with the 2nd lamp 14b that enclosed only the rare gas 15a which covers the longitudinal direction outer peripheral part of the 1st lamp section 14a, and is discharged by microwave inside.

[0020]Under the present circumstances, in the 1st lamp 14a of the electrodeless lamp 14. As the rare gas 15a discharged by microwave, argon, neon, Metal halogenides, such as gallium indium thallium, mercury, zinc, sulfur, selenium, a tellurium, etc. are enclosed as the discharge medium 15b which a xenon, krypton, etc. are enclosed and is discharged by microwave. On the other hand, in the 2nd lamp 14b of the electrodeless lamp 14, argon, neon, a xenon, krypton, etc. are enclosed as the rare gas 15a discharged by microwave. And the gas pressure of the rare gas 15a in the 2nd lamp 14b and gas volume are set up so that the electrodeless lamp 14 may be mentioned later and the 2nd outside lamp 14b can start discharge ahead of the 1st inside lamp 14a. Of course, since there is no electrode into the 1st and 2nd lamp section 14a of the electrodeless lamp 14, and 14b, reinforcement can be attained. Although the both ends of the 1st lamp section 14a of the electrodeless lamp 14 are formed hemispherical in the example, without restricting to this, both ends may be formed in a flat and protuberance form may be sufficient as the end of the direction which is not an outgoing radiation side of light.

[0021]Under the present circumstances, the electrodeless lamp 14 has adhered in the narrow diameter portion 11a of the resonator 11 via the permanent magnets 12 and 13 of a couple by filling up with or sintering the dielectric ceramics which are not illustrated between the permanent magnets 12 and 13 of a couple, and the electrodeless lamp 14.

[0022]When attaching the permanent magnets 12 and 13 of a couple in the narrow diameter portion 11a of the resonator 11, So that the direction of the lines of magnetic force 12a and 13a by which it is generated from the permanent magnets 12 and 13 of a couple, respectively may become parallel to the longitudinal direction of the 1st lamp section 14a of the electrodeless lamp 14, and the emission direction (arrow direction) of the emitted light L from this electrodeless lamp 14. The south pole and the n pole of each magnets 12 and 13 are set up, respectively.

[0023]The magnetron 16 which generates microwave is attached to the outside of the base part 11b1 of the major diameter 11b of the resonator 11. The antenna 17 which sends the microwave generated in the magnetron 16 has projected in the major diameter 11b of the resonator 11. Electric power is supplied in the electrodeless lamp 14 in the microwave which the microwave sent from the antenna 17 resonated within the major diameter 11b of the resonator 11 by this, and resonated.

[0024]And in the electrodeless lamp 14, the rare gas 15a in the 2nd lamp section 14b will start discharge first by the microwave which resonated, it will be in the plasma state, and, thereby, the impedance in the 2nd lamp section 14b falls. Since it becomes easy to concentrate

microwave on the 1st lamp section 14a in connection with this, The rare gas 15a in the 1st lamp section 14a will discharge, will be in the plasma state, the electric power included in the electrodeless lamp 14 whole increases, and the temperature of the glass wall of the 1st lamp section 14a of the electrodeless lamp 14 rises, The metal in the discharge medium 15b enclosed in the 1st lamp section 14a evaporates, and it dissociates and condenses by a hot section, and becomes particles, and this particle carries out spectrum luminescence peculiar to metal with heating of discharge. This particle moves to the low temperature part in the 1st lamp section 14a of the electrodeless lamp 14, and after metalizing by a reaction with hydrogen and oxygen, it repeats evaporation, dissociation, condensation, and luminescence.

[0025] Since the direction of the lines of magnetic force 12a and 13a by which it is generated from the permanent magnets 12 and 13 of a couple, respectively is parallel to the longitudinal direction of the 1st lamp section 14a of the electrodeless lamp 14, and the emission direction (arrow direction) of the emitted light L from this electrodeless lamp 14 here, By the direction of the lines of magnetic force 12a and 13a. Since it rotates spirally between the line of magnetic force 12a and 13a as shown in drawing 2 toward the emission direction by the side of the opening 11a which the electron by which the electron cyclotron resonance happened and it was generated in the 1st lamp section 14a of the electrodeless lamp 14 formed in the narrow diameter portion 11a of the resonator 11, The emitted light L is emitted from the opening 11a formed in the narrow diameter portion 11a of the resonator 11. Under the present circumstances, the turning radius (Larmor radius) of the electron by which it was generated in the 1st lamp section 14a of the electrodeless lamp 14 is smaller than diameter of lamp phiD of the 1st lamp section 14a of the electrodeless lamp 14 enough, And can lengthen dramatically the luminescence path (distance) and light emission period of light in electronic spiral rotational movement, and. Distance until an electron collides with the lamp wall of the 1st lamp section 14a and loses energy can also be lengthened, and while the electron is exercising freely, the energy of the microwave currently collided and consumed in the lamp wall can be exploited efficiently.

[0026] By arranging the permanent magnets 12 and 13 of a couple on both sides of the electrodeless lamp 14 so that a line of magnetic force parallel to the longitudinal direction of the 1st lamp section 14a of the electrodeless lamp 14 since it becomes easy to start a electron cyclotron resonance so that magnetic flux density is high may be formed, Magnetic flux density becomes high and the neighborhood of the central part of the longitudinal direction of the 1st lamp section 14a of the electrodeless lamp 14 emits light strongly cylindrical. And the light which emitted light is taken out from the hemispherical end of the 1st lamp section 14a of the electrodeless lamp 14 as the emitted light L. carrying out the opening of the opening 11a formed in the narrow diameter portion 11a of the resonator 11 to substantial verticality here to the direction of the lines of magnetic force 12a and 13a -- the opening 11a -- the light flux of

the emitted light L -- abbreviated -- it becomes a form where a perpendicular section is taken, and it is bright in the central part of the emitted light L, and the point light source of a small area is acquired.

[0027]Next, the microwave discharge light equipment 10A of the 1st example shown in drawing 1 is explained simple using drawing 3 about the 1st modification that transformed the part. At drawing 3, the same code number is attached to the members forming and the identical configuration member of the microwave discharge light equipment 10A of the 1st example which were explained previously, and the following explanation explains only a different point from the microwave discharge light equipment 10A of the 1st example explained previously.

[0028]As shown in drawing 3, in the microwave discharge light equipment 10B of the 1st modification. By attaching the lid 18 which drilled the feed hole 18a not more than abbreviated 1mm in the opening 11a1 which carried out the opening for the diameter sufficiently smaller than diameter of lamp ϕ 1D of the 1st lamp section 14a of the electrodeless lamp 14 at the tip of the narrow diameter portion 11a of the resonator 11. The emitted light L emitted from this feed hole 18a is obtained as the clearer point light source, and the emitted light L can be efficiently taken out as the effective area product of the feed hole 18a is small. The effect of preventing the disclosure to the exterior of microwave by using a metallic material for the lid 18 which drilled the feed hole 18a, or using for it combining a wire gauze and a shielding member is acquired.

[0029]Next, the microwave discharge light equipment 10A of the 1st example or the microwave discharge light equipment 10B of the 1st modification shown in drawing 1 is explained simple using drawing 4 about the 2nd modification that transformed the part. At drawing 4, the same code number is attached to the members forming and the identical configuration member of the microwave discharge light equipment 10A and 10B which were explained previously, and the following explanation explains only a different point from the microwave discharge light equipment 10A and 10B explained previously. What is necessary is just to attach the lid 18 if needed in the 2nd modification, although the lid 18 which drilled the feed hole 18a not more than abbreviated 1mm at the tip of the narrow diameter portion 11a of the resonator 11 is attached in drawing 4.

[0030]Since the temperature of the electrodeless lamp 14 becomes abbreviated 500 degrees C-1000-degreeC and an elevated temperature by microwave here in the above mentioned microwave discharge light equipment 10A of the 1st example or the microwave discharge light equipment 10B of the 1st modification, Intensity of magnetization will reduce extremely the permanent magnets 12 and 13 of the couple provided in the narrow diameter portion 11a of the resonator 11 according to the high temperature from the electrodeless lamp 14. Of course, even when an electromagnet is used without using the permanent magnets 12 and 13, it

demagnetizes like the above.

[0031]Then, as shown in drawing 4, in the microwave discharge light equipment 10C of the 2nd modification, couple maintenance is carried out using the attachment component which counters mutually the outside of the narrow diameter portion 11a of the resonator 11, and does not illustrate the falcate permanent magnets 12 and 13 on it. Although the permanent magnets 12 and 13 of the couple were made to counter mutually and are provided also in the 2nd modification, it is larger for an effect at least for either to have been good and for there to be two or more pairs further, without restricting to this. It is also possible to use the permanent magnet of doughnut shape (ring shape), to replace with a permanent magnet, and to use an electromagnet.

[0032]When forming the permanent magnets 12 and 13 of a couple in the outside of the narrow diameter portion 11a of the resonator 11, at least here the narrow diameter portion 11a part of the resonator 11, By forming using a small material of relative permeability, or forming using the existing conductive meshed material, the influence of the high temperature from the electrodeless lamp 14 can be reduced, and the lines of magnetic force 12a and 13a can be centralized.

[0033]The microwave discharge light equipment 10A (or 10B or 10C) by the above-mentioned composition, The rare gas 15a and the discharge medium 15b are enclosed with the 1st lamp section 14a of the inside which can attain reinforcement with the electrodeless lamp 14, and constitutes the electrodeless lamp 14, By enclosing only the rare gas 15a with the 2nd lamp section 14b of the outside which constitutes the electrodeless lamp 14, First, since the rare gas 15a in the 2nd lamp section 14b will start discharge by the microwave which resonated, it will be in the plasma state and the impedance in the 2nd lamp section 14b falls by this, In connection with this, it becomes easy to concentrate microwave on the 1st lamp section 14a, an electron emits light easily within the 1st lamp section 14a, and spectrum luminescence peculiar to metal can be carried out. By what the lines of magnetic force 12a and 13a parallel to the longitudinal direction of the 1st lamp section 14a of the electrodeless lamp 14 and the emission direction of the emitted light L from this electrodeless lamp 14 are given to the electrodeless lamp 14, and the luminescence path (distance) and light emission period of light are lengthened for. By raising and carrying out the rise in luminosity of the discharge efficiency to the emission direction of the emitted light L, and making the emitted light L emit from a small area, the emitted light L from the electrodeless lamp 14 can be used as the point light source.

[0034]The sectional view showing the microwave discharge light equipment of the 2nd example that requires <2nd example> drawing 5 for this invention, The sectional view showing the 1st modification that transformed drawing 6 for some microwave discharge light equipment of the 2nd example, In the microwave discharge light equipment shown in drawing 5 - drawing 7, the sectional view showing the 2nd modification that transformed drawing 7 for some

microwave discharge light equipment of the 2nd example, and drawing 8 are the perspective views expanding and showing a loop gap resonator.

[0035]The microwave discharge light equipment 20C of the 2nd modification that transformed a part of 2nd example shown in the microwave discharge light equipment 20B and drawing 7 of the 1st modification which transformed a part of 2nd example shown in the microwave discharge light equipment 20A and drawing 6 of the 2nd example concerning this invention shown in drawing 5, There is a correspondence relation to the microwave discharge light equipment 10A, 10B, and 10C in the 1st example described previously, respectively, and here attaches and explains a new code number only about a different point from the microwave discharge light equipment 10A, 10B, and 10C in the 1st example.

[0036]In the microwave discharge light equipment 20A (or 20B or 20C) shown in drawing 5 (or drawing 6 or drawing 7), It is an outgoing radiation side of the light of the electrodeless lamp 14 formed in the narrow diameter portion 11a of the resonator 11, and the loop gap resonator 21 of the shape of a tube used as the important section of the 2nd example is formed on the optic axis K of this lamp 14. Under the present circumstances, the axis direction of the loop gap resonator 21 becomes parallel to the emission direction (arrow direction) of the emitted light L from the electrodeless lamp 14 by doubling the medial axis of the loop gap resonator 21 with the optic axis K of the electrodeless lamp 14, and. To the optic axis K of the electrodeless lamp 14, the loop gap resonator 21 intersects perpendicularly abbreviated, and is formed. In an example, although the loop gap resonator 21 is formed in the outgoing radiation side of the light of the electrodeless lamp 14, it may provide in the both ends of the electrodeless lamp 14.

[0037]By what is filled up with the dielectric ceramics which are not illustrated between the outer peripheral part of the tube-like loop gap resonator 21, and the outer peripheral part of the electrodeless lamp 14 and/or the inner circumference part of the permanent magnets 12 and 13 of a couple. The loop gap resonator 21 serves as structure which has the same resonance frequency as the resonator 11 united with the resonator 11. The structure gestalt which has electromagnetic induction nature and electric capacity nature so that it may mention later is used for the loop gap resonator 21.

[0038]Namely, as shown in drawing 8, expand and the loop gap resonator 21, It consists of the resonance ring part 21a of the shape of an approximate circle pipe which consists of conductive materials, such as copper, aluminum, and silver, and the gap part 21b which cut and lacked a part of this resonance ring part 21a by thin width, and inside diameter ϕ id of the resonance ring part 21a is formed smaller than diameter of lamp ϕ id of the 1st lamp section 14 of the electrodeless lamp 14. Although the one gap part 21b was formed in the tube-like resonance ring part 21a in the example, It is also possible to use looped shape electromagnetically by forming two or more gap parts 21b in the tube-like resonance ring part

21a, and filling up with and holding dielectric ceramics to each gap part 21b, without restricting to this.

[0039]Here, since the resonance ring part 21a has electromagnetic induction nature when the axis direction of the loop gap resonator 21 is arranged so that it may become the direction of the magnetic flux of a change electromagnetic field, and parallel, spiral induced potential arises in a circumferencial direction, an electric field produces in the gap part 21b by this, and it has electric capacity nature.

[0040]Therefore, in the microwave discharge light equipment 20A (or 20B or 20C). By drawing the energy of microwave in the electrodeless lamp 14 efficiently with the loop gap resonator 21, raising and carrying out the rise in luminosity of the discharge efficiency to the emission direction of the emitted light L of the electrodeless lamp 14, and making the emitted light L emit from a small area. The emitted light L from the electrodeless lamp 14 can be used as the point light source.

[0041]The lineblock diagram showing a transmission type case as an image display device using the microwave discharge light equipment which <3rd example> drawing 9 requires for this invention, and drawing 10 are the lineblock diagrams showing a reflection type case as an image display device using the microwave discharge light equipment concerning this invention.

[0042]First, as shown in drawing 9, the transmission type image display device 30, The emitted light L emitted from the electrodeless lamp 14 which constitutes the microwave discharge light equipment 10A-10C (or 20A-20C) in the 1st example (or the 2nd example) described previously is irradiated by the transmission type liquid crystal board 32 with the lens 31. This transmission type liquid crystal board 32 displays a desired picture with the picture signal from the liquid crystal driving circuit 33. The image light G which penetrated the transmission type liquid crystal board 32 is expanded with the projector lens 34, and enlargement projection is carried out on the screen 35.

[0043]By therefore, the thing which you raise and carry out the rise in luminosity of the discharge efficiency to the emission direction of the emitted light L of the electrodeless lamp 14 using the microwave discharge light equipment 10A-10C (or 20A-20C) explained previously, and is made to emit the emitted light L from a small area. Since the emitted light L from the electrodeless lamp 14 can be used as the point light source, it is low power consumption as a light source for projection of the transmission type image display device 30, and the enlargement projection of the picture can be carried out to high-intensity / high definition / high definition.

[0044]Next, as shown in drawing 10, writing light W according to a picture signal is irradiated with the reflection type image display device 40 by one field 41a of the optical address type spatial modulation element 41, light information is written in, and this light information is

amplified inside.

[0045]The emitted light L emitted from the electrodeless lamp 14 which, on the other hand, constitutes the microwave discharge light equipment 10A-10C (or 20A-20C) in the 1st example (or the 2nd example) described previously. It enters into the polarization beam splitter 45 through the infrared ray cut filter 42, the lens 43, and the wavelength filter 44. It is reflected with the semi transmission reflection film 45a of the polarization beam splitter 45, and catoptric light is irradiated by the field 41b of another side of the optical address type spatial modulation element 41, and is reflected as reading lighting R which contained picture information in respect of [41b] this another side. Then, reading lighting R having contained picture information penetrates the semi transmission reflection film 45a of the polarization beam splitter 45, is expanded with the projector lens 46, and enlargement projection is carried out on the screen 47.

[0046]By therefore, the thing which you raise and carry out the rise in luminosity of the discharge efficiency to the emission direction of the emitted light L of the electrodeless lamp 14 using the microwave discharge light equipment 10A-10C (or 20A-20C) explained previously, and is made to emit the emitted light L from a small area. Since the emitted light L from the electrodeless lamp 14 can be used as the point light source, it is low power consumption as a light source for projection of the reflection type image display device 40, and the enlargement projection of the picture can be carried out to high-intensity / high definition / high definition.

[0047]

[Effect of the Invention]In the microwave discharge light equipment concerning this invention concerning this invention explained in full detail above, according to the claim 1 statement, reinforcement being attained with an electrodeless lamp and, By enclosing rare gas and a discharge medium with the 1st lamp section of the inside which constitutes an electrodeless lamp, and enclosing only rare gas with the 2nd lamp section of the outside which constitutes an electrodeless lamp, First, since the rare gas in the 2nd lamp section will start discharge by the microwave which resonated, it will be in the plasma state and the impedance in the 2nd lamp section falls by this, In connection with this, it becomes easy to concentrate microwave on the 1st lamp section, an electron emits light easily within the 1st lamp section, and spectrum luminescence peculiar to metal can be carried out. By what the 1st lamp section of an electrodeless lamp and a line of magnetic force parallel to the emission direction of the emitted light from this electrodeless lamp are given to an electrodeless lamp, and the luminescence path (distance) and light emission period of light are lengthened for. By raising and carrying out the rise in luminosity of the discharge efficiency to the emission direction of emitted light, and making emitted light emit from a small area, the emitted light from an electrodeless lamp can be used as the point light source.

[0048]According to the claim 2 statement, the same effect as claim 1 statement is acquired,

and. The emitted light from an electrodeless lamp can be used as the point light source by drawing the energy of microwave in an electrodeless lamp efficiently with a loop gap resonator, raising and carrying out the rise in luminosity of the discharge efficiency to the emission direction of the emitted light of an electrodeless lamp, and making emitted light emit from a small area.

[0049] Since the point light source by the performance of the above-mentioned electrodeless lamp is used as a light source for projection for image display according to the image display device using the microwave discharge light equipment concerning this invention, It can contribute to the low power consumption of an image display device, and the enlargement projection of the picture can be carried out to high-intensity / high definition / high definition with microwave discharge light equipment.

[Translation done.]